REMOTE SENSING EVALUATION

August, 1980

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Remote Sensing Evaluation Report

A. G E N E R A L

1. INTRODUCTION

As part of a Centre initiative, through the Office of the Vice-President, Planning, to examine certain Centre policies, activities and programmes, it was decided to evaluate four of five projects which the Centre had supported in the field of remote sensing.(1)

2. MISSION

The recruited team comprised Tony Price, ex-Centre Regional Director at both WARO and EARO, and Bill Bruce of the Canada Centre For remote Sensing (CCRS). The former was selected for his familiarity with Centre policies and practices and experience in developing countries, particularly of Africa; the latter for his knowledge of remote sensing, and especially of its applications, and involvement in international programmes of the CCRS.

3. MISSION ORGANIZATION

The general period allocated to the evaluation was six weeks of which four weeks were allocated to visiting the four selected

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project sites and the balance to preparatory meetings and studies, and final report writing.

Various meetings were held in Ottawa between July and November 1979 involving J. Woolston, and D. Daniels, M. Brandreth, R. Leblond, A. Price and B. Bruce. Terms of reference and objectives were defined and the individual project leaders were contacted by cable, letter and, in several instances, by the responsible Regional Office as well. Project visits were made in the month of November 1979 to Mali, the Sudan and Tanzania. The team also travelled to South America but was unable to visit Bolivia due to a coup d'état in the country.

Particular appreciation was expressed by our hosts over the following aspects of the mission's organization:

- notice was given a generous time prior to arrival,
- the letter advising of the mission was explicit as to its objectives (the format of specific questions was especially complimented), and
- we stayed a sufficient time to suit the convenience of our hosts and to accomplish our own work (rather than visit "entre avions" as the Malians say, with some feeling, is the common practice of international missions coming to their country).

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Price had requested that letter copies of all cables be sent. This should be "de rigueur" in Africa. It is possible this was not done in all cases as the Sudanese said they had no word of our precise arrival time although a cable with this detail was sent on October 26.

The travel programme was quite punishing. The South America to West Africa leg was 20 hours. Later, in one day, Price went Bamako-Dakar-Nouakchott-Casablanca-Paris-Geneva (3 flights) and Bruce went Bamako-Paris-Athens-Khartoum in 20 hours. (3 flights also). This goes with the work; it is a statement and reminder, not a grievance!

4. OBJECTIVES

The basic objectives were to evaluate the performance and results of the projects, more individually than comparatively, and to examine the more general issue of the feasibility and methodology of the transfer of relatively advanced technologies to countries notably poor in human and material resources, and remote sensing technology in particular.

It has been stated that, strictly construed, the Centre's mandate does not include technology transfer but that, nevertheless, in exceptional

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instances where the payoff potential is high, such an activity should not be peremptorily excluded. The formal objectives set for the mission were as follows:

i) to determine whether the individual projects have achieved their objectives and whether the project activities were efficiently and effectively carried out;

ii) to assess whether the project objectives were realistic and achievable with the human, institutional and financial resources available;

iii) to assess whether these projects have contributed to the development of scientific personnel and institutional capability and whether the capacity now exists to carry this work on with their own resources;

iv) to assess whether the Centre's role and involvement in developing and supporting these projects has been appropriate and whether it could be changed to be more useful;

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v) to assess whether these projects have made, are likely to make, or could make any useful contribution to the development of the countries involved, whether in the short, medium or long term;

vi) to assess whether the results of a project in one country can have any regional benefits;

vii) to assess whether there were any general benefits betweeen or linkages between the five projects supported in this programme or linkages created with other countries and organizations involved in the same kind of activity;

viii) to assess whether the experience gained in these projects can or has provided any useful guidelines or methodology which can be used in the transfer of this or other technologies to other developing countries;

ix) to comment on the appropriateness of the IDRC supporting this type of programme and the value or effect of supporting additional projects of this kind in other developing countries.

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Ancillary issues included the following:

i) Is remote sensing a technology at all relevant to LDC's, and more especially to the poorest ones?

ii) Is remote sensing a technology susceptible to transfer from an executing agency to a user?

iii) Was there any "research" in these projects, or were they strictly technology transfer? If the latter, should the Centre be involved in such an activity?

iv) Were the project designs adequate and appropriate?

v) What is the real, immediate, potential assimilation of the technology, at policy and management levels, in each country?

vi) Did the project enhance in the countries the ability to negotiate access to international landsat data?

vii) Which training package proved the most effective and appropriate?

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If we may extract from the above the most central issues, they seem to be:

- as a result of the Centre-supported activity, is there in place in each country a team able to carry on remote sensing work?

- is there a clientele for this team, i.e. are the results of remote sensing perceived by potential users to be useful and being, or likely to be used.

- the general issue of the feasibility of the transfer of relatively high technology to poor countries and how this might best be accomplished.

The mission was to make it clear that it was not a project identification exercise, nor was it a financial and administrative investigation.

The authors of the report have attempted to record faithfully what of importance and pertinence was said to them during the mission, without intending thereby to suggest that they accept these statements as fact. Where statements have been questioned or explained

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by is division staff members, and the authors felt it important to record their comments, such comments have been summarized and inserted in brackets. We believe, for a report like this, it is important to know what people think to be the case, or what they say, as well as what is in fact strictly accurate.

5. TECHNOLOGY

The acquisition and processing of image data from satellites and aircraft undoubtedly lies in the domain of high technology. In fact, the sophistication of this technology is increasing steadily. Does this say, however, that the use or application of the outputs of this technology must also be considered high technology? A general definition may help clarify this question.

Remote sensing may be described as a process which can assist in the recording, identification and the determination of a meaning or significance of objects or phenomena on the earth's surface using sensing devices which are not in physical contact with those objects or phenomena. As noted, remote sensing is a process. It contains two very distinct elements. The first, using primarily devices which extend our natural sense of sight, is the acquisition of data. The conversion of this data into useful information about objects or phenomena is the second, and a very separate, element. While the

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first depends primarily on the knowledge, experience and capabilities of the human observer. Although technology too can aid this latter operation, the level is not necessarily high.

The technology for useful visual interpretation depends upon several factors. Primarily it must be appropriate: to the study of the desired objects or phenomena; to the nature of the problem involving these; to the precise information needs; and to the capability of the human interpreter.

Although there are some very sophisticated technologies available to support these activities, they are only occasionally the most appropriate ones. The weight of evidence indicates that, in the application of remote sensing, operational success more often equates with simplicity than sophistication in the level of technology selected, with principle concern always appropriateness. Opinions to the contrary usually arise from situations where availability of technology is seen to equate with the need for its application. We, in the developed world, are the most susceptible to this temptation. We must take caution that this response is not unnecessarily transferred to the developing world.

The four IDRC projects, which are the subject of this evaluation mission, in fact provide very instructive examples of the consequences

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of the application of appropriate and inappropriate technology for the evaluation of remotely sensed data. Whereas remote sensing data acquisition and processing are necessarily sophisticated technologies, it is clear that the extraction of information from this data need not be. The human element in this latter process makes the difference.

6. REMOTE SENSING TECHNOLOGY TRANSFER

This task is not as simple or direct as it may appear. Successful technology transfer, and not only in the field of remote sensing, is based upon several elements. A brief review of these elements will establish the perspective upon which this evaluation is predicated.

a) Access

Before all else, access is vital and must not be assumed. Barriers to access exist. They may be externally imposed(cost, space policy, availability of data, etc.), but this is rarely the critical factor. The barriers are more often internal (lack of awareness, lack of information, language, etc.). The internal barriers must be accepted and overcome if the transfer process is to go beyond this point.

b) Expertise

Effective use of technology requires expertise. The development of this expertise requires training. Because it is the application of

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the remote sensing which is important beyond simple acquisition, this traning must be applied to a sound base of discipline expertise relevant to the study of earth resources. The human element is so critical that no efforts at transfer will succeed without this pre-requisite expertise.

c) Experience

Whereas training can accomplish knowledge transfer, this is not the same necessarily as capability transfer. Familiarity with the tools does not equate with proficiency in their use. It is, in fact, the apprenticeship which is critical and this cannot be compressed into a "short course". Some provision must, therefore, be made to support this apprenticeship, through until adequate proficiency is acquired, however long, within reason, this may take in given circumstances.

d) Equipment

The carrying out of this apprenticeship and the continued use of the technology of course requires the material tools. The selection of the appropriate tools is critical and must be compatible with the level of access and expertise fostered by the previous stage .

e) Management

Those who have the expertise to apply the tools unfortunately are infrequently in a position to ensure that there will be opportunities

for their application. Any technology transfer programme must therefore consider the critical importance of the manager. Without the active support and direction provided by informed and capable management, the infusion of new technology, however useful, will be slowed or stifled. A conscious and specific effort must therefore be directed at management to ensure that available expertise is utilized wherever possible to the best advantage.

f) Mandate

The acquisition of remote sensing is not an end in itself. If real benefits of the technology are to be felt, it can only be through an agency which has an operational mandate to acquire and use the kinds of information which remote sensing can help provide. In few cases can developing countries afford the luxury of groups engaged in abstract technology research for its own merit. Research can and must be encouraged, but toward operational or applied goals. Thus the choice of a group or agency to be the core of any technology transfer effort may be among the most important decision made to this point.

g) Policy

This last element is often ignored or, if recognized, is avoided because those who are scientifically involved in technology transfer rarely have

the power to influence it. One has proceeded to this stage on the assumptions that knowledge of resources is a prerequisite for intelligent development and that it is to the ends of resource inventory evaluation and management that remote sensing can make its contribution. If, however, there is no positive, meaningful policy commitment which recognizes the need for such activities, and co-ordination and communication among the various resource oriented ministries and agencies, all other efforts are ephemeral.

In the absence of policy commitment, work can still go on, advances can be made if very slowly and resource understanding can be increased - but all to what end? Policy can, of course, be influenced. It will most effectively be influenced by active agencies with competent management which grasps the technology; which is confident in the expertise of its staff; which provides the necessary support for expertise to be exercised effectively and which is convinced of the usefulness of the technology for national development.

Technology transfer sounds like a very involved and complicated process and, indeed it is. Although a donor agency cannot and would not wish to control all of the foregoing elements, recognition of their importance can be of vital assistance in our own planning and selection process and especially in our perception of the realitites and practicalities of technology transfer to any given less-developed country.

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B. INDIVIDUAL PROJECTS

1. PROJECTS VISIT PROGRAMME

Latin America:	Bruce -- November 1-10
	Price -- November 3-7
Mali:	Bruce -- November 12-16
	Price -- November 9-15
Sudan:	Both -- November 17-21
Tanzania:	Both -- November 22-28

Due to the Bolivian situation, which caused Bruce and Price to await developments respectively in Lima and Bogota, the team took a little time to assemble in Africa. It, nevertheless, arrived in Bamako on schedule. Generally, one day in each African country was spent establishing that the team had come when it said it was coming. Thereafter, programmes were generally well, cooperatively and courteously arranged and most of the people we wished to see either attended the meetings or otherwise were made available for interviews.

Given time constraints and the nature of things in the countries visited, it was not possible either to visit rural areas or to meet with many so-called "policy-makers".

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At the first meeting, we would explain the objectives of the evaluation and go through the specific questions. This would be followed generally by meetings with trainees, examination of equipment, reviewing thematic maps, etc. Then there would be a wrap-up meeting of a general nature. With slight variations this format was followed in all three countries.

2. BOLIVIA

As a coup d'état occurred the day the mission was to arrive in La Paz, it did not carry out this part of the evaluation. Instead L.R. Beltran, the Assistant Regional Director at LARO, was given copies of the mission's documents relating to the Bolivia project, and briefed generally on its objectives, and it was to be decided by the VPP if he should carry out an evaluation as best he could when conditions in the country permitted.

From all that the mission heard, Carlos Brockmann, the Project Director, is a man of unusual ability and commitment and if this project may be said to have out-performed the others, this is attributed more to this fact than necessarily to superior institutional conditions and human resources in his country. It is not unusual in the less-developed countries, with trained people still in short supply, and where an outstanding individual can have an extraordinarily positive impact, to see the activity for which he or she is responsible perform significantly above what may be considered the national norm.

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("All too frequently, in those developing countries where remote sensing has taken hold, it has often been confined to a single agency under the direction of a single dedicated specialist. Thus, there is a need to develop networks and linkages, both internally and externally." - Mervill Conitz USAID).

(In fact Mr. Beltran did go to Bolivia in mid December to carry out the evaluation. He subsequently produced a substantial, technical report which obviously involved a great deal of study and effort on his part. Because of the wide difference in approach, content and style between his report and the reports on the Africa projects, it was not felt they could practically be combined.

Bill Bruce made many margin comments on, and qualifications to, statements in the Beltran report which should be carefully reviewed before any separate publication of it is made. It should be cautioned that, because it read as a technical report by a scientist in the discipline, it will be judged as such. Again, as an ostensibly technical report by a non-technical person, it was not felt useful to open up what could be an interminable dialogue between technical and non-technical people by recording here Mr. Bruce's specific comments etc. on the Beltran report).

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3. MALI

a) Mission Programme

It being the Mecca pilgrimage season, and a Monday flight to Bamako not being indicated in the Airline Guide, when Bolivia was cancelled Price thought it best to carry on to Bamako as soon as possible and arrived November 9. Bruce, travelling from Lima, Peru, arrived November 12 as originally scheduled. (In the event this Monday flight had been cancelled the three previous Mondays).

Contact was immediately established November 10 with Hilarion Traore, Directeur Général Adjoint of the Direction Nationale de la Géologie et des Mines, which is part of the Ministère du Développement Industriel. Sékou Diallo, the Directeur, was absent that day.

On November 12, Price met briefly with Diallo to arrange a programme. At this meeting, a written response to the questions posed in our letter was produced. It is attached herewith as Annex I.

A general meeting was held November 13 at which were present, in addition to Bruce and Price:

Diallo, Sékou	Directeur Général
Traore, Hilarion	Directeur Général Adjoint

Samake, Cyr Mathieu	Chef, Bureau des Etudes
Diallo, Moctar (alias Mamadou, brother of Sékou)	Hydrogéologue (Leningrad)
Bouaré, Seydou	Géographe
Doumbia, Oumar	Agro-pédologue, Institut de l'Economie Rurale

That afternoon, a further meeting was held with Moctar Diallo, Bouaré, Doumbia and Ousmane Abdou Maiga who had just arrived from holidays after a difficult journey from Gao, having travelled to Bamako especially for the meetings. (Sékou Diallo and O.M. Maiga were the Malian participants at the Nairobi meeting.)

A "réunion de sythèse" was scheduled November 14. Unfortunately it only got underway an hour and a half late, at the end of the day, and without the Directeur Général who, allegedly, was detained by his Minister. (He came to the airport the next morning, at 0:700 , to apologize.)

A number of attempts were made to see a Miss Gail Chance of USAID, who is Programme Officer there for a pending USAID-supported remote sensing project, but, whether deliberately or otherwise, she was never in when we called and did not respond to several messages we left.

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On November 15, Bruce met with M. Diallo and A. Maiga as well as other interested staff at the Direction National de la Géologie et des Mines. The purpose of these discussions was to review the research and mapping activities carried out under IDRC sponsorship. The mission was also anxious in such meetings to encourage the expression of participant reactions in a more informal atmosphere. It is apparent that both Diallo and Maiga have the interest and ability to develop interesting and potentially useful topics of research incorporating remote sensing.

b) Project Negotiations

As it is of course virtually everywhere, and regardless of the fact that the ERTS Mali Bureau was established in 1970, remote sensing is a relatively new activity in Mali.The Ministry, we believe, had never dealt before with the IDRC, which also was probably pretty green in the field. This undoubtedly accounts for some misconceptions, misunderstandings and errors referred to later on. In particular, the Malians claimed they were unable to estimate accurately how much time it would take to do particular phases and operations. They expressed the opinion that the project ended just as results were beginning to show.

A good deal of care, generally, should be taken to ascertain that the proffered local contribution is realistic (which, nevertheless, will always be difficult for a donor to determine diplomatically). In particular, the vehicle arrangements were quite unrealistic in the circumstances of Mali.

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It must be borne in mind that a poor country will often agree to almost anything as the local contribution, no matter how unrealistic in terms of its resources and capabilities, because a more important concern is to "have a project" which will bring external financing and provide jobs and equipment and perhaps some training as well. It is felt, if it is consciously considered at all, that these things can be sorted out later on.

As the project was fully drafted by Mamadou Konaté, Directeur of the Direction de la Géologie et des Mines from 1970 to 1975, the aforementioned shortcomings and misjudgments seem less easily explained. It should be emphasized here however that M. Konaté had little involvement with the actual carrying out of the project drafted.

c) Project Schedule

As best we could ascertain, the schedule appears to have been approximately as follows:

February-April 1977	- introduction to the subject; - logistical organization
Late April-mid-September 1977	- first training period (in France)
November 1977- April 1978	- field work
April-June 1978	- second training period (in France); - final report

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It should be noted that in Mali, because of the rainy-dry seasonal pattern, operations in a year are divided as follows:

July-October (rain)	"hivernage" (logistical preparations)
October-July (dry)	"campagne" (field work)

This project only had one "campagne" for field work and everybody felt it should have had two The first "compagne" raised questions which should have been tackled in the second "campagne". The real work really began only in April 1977 so the effective life of the project was 14 months instead of the intended 20.

The GCL is dated October 21, 1976, and was accepted by the Malians on February 18, 1977, so theoretically the project could have run until October, 1978, which still would not have allowed time, assuming there were unexpended funds, for the desired second "campagne" of another round of field work. The Malians, incidentally, feel there were unexpended funds, if perhaps not enough to finish properly. Is this so?

Allegedly R. Leblond insisted that the project end in accordance with the stipulated agreement termination limit and an extension was never seriously considered by IDRC although it may have been perhaps if solicited un officially.

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It was subsequently explained to us that funds advanced had not been properly accounted for and IS Division and Treasurer could not recommend further payments until they were.

Two superficial comments:

- The project got underway a couple of months late which accounts for some of the project time without accomplishment.

- In future, in preparing project schedules for countries with seasons which strictly determine what kind of work can be done, and where and when, care should be taken that the schedule is as consonant with this circumstance as possible.

d) People

S. Diallo appears a bit disorganized, indefinite, perhaps a little burnt out. Traore, a Grenoble-trained geologist (mining engineer?), is composed and impressive, M. Diallo is quick, perhaps mercurial, and forthcoming. Doumbia and Maiga exhibited considerable professional interest, seriousness and enthusiasm. The others, who were less involved in the project, left no particular impression worth reporting upon.

The principal trainees on the project were: M. Diallo, O.M. Maiga, O. Doumbia, and Mohammed Ad Hammaty. Only the two former are presently with the ERTS Mali unit in the "Direction". Doumbia is with the

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Institut de l'Economie Rurale (working on soil maps) and Hammaty is the forestry officer in Sikasso. Sine Camara, who did a month's training in technologie de traitement d'images, is now the Directeur of the Ecole Nationale d'Ingénieurs. They feel that, although several have left remote sensing activities per se, there still exists a team which can be re-assembled should there be need, interest and funding.

e) Training

There were four full "stagiaires" (Diallo, Maiga, Doumbia and Hammaty) and one one-month only "stagiaire" (Sine Camara in the specific field of "technologie de traitement d'images").

Only the "stagiaires" worked on the project.

Their present occupations are dealt with in paragraph d) above.

For training purposes, image work was separated from aerial photo work. The training phase was divided between visual image interpretations and machine analysis. It is appropriate that major emphasis was placed on establishing a broad background in visual interpretation techniques. Current experience confirms that human, visual analysis is vital for a successful application of computerized, image processing techniques.

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If placed in perspective with user needs, nowever, these more technologically sophisticated techniques can provide much valuable support to visual interpretation.

Satisfaction generally was expressed with the training provided and organized by the Groupement pour le Développement de la Télédétection Aérospatiale (GDTA) and with Max Guy who was in charge of the programme.

f) Equipment

Not unexpectedly (it is standard in Africa), vehicle arrangements came in for criticism. The GCL stated that the recipient would provide maintenance and petrol for five vehicles. The Malians now say this should have been expressed as "five vehicle months" of maintenance, etc. In the event, it is alledged that a serious deficiency of vehicles, spare parts, petrol, etc. handicapped the work. (No donor has yet fathomed how to provide, safely and effectively, good transport for projects in most African countries. If you provide vehicles, invariably they are roughly driven, poorly maintained, and used for other than project purposes. If you do not, you offer a patent excuse for non-performance and it will be made every time.) The Malians say they asked for vehicles and were told that "the IDRC does not provide vehicles".

Of the equipment list in the GCL, the Malians say that they did not receive the following:

Densitometer and Magnetometer	$14,000
Colour additive viewer	9,000
Camera and Accessories	1,500
Materials for Analysis	2,000

and state ignorance about why. Also, again for reasons they purport not to know, the project work which was to be done in Bamako with this equipment was in fact done in France.

They say that they understand that the funds budgeted for equipment were transferred to "Training" and were in fact expended on additional training (the second "stage"). They state that they presently do not have the equipment necessary for image interpretation work and, in the medium term, must order images from outside the country at considerable cost. Allegedly again, a consignment of small instruments and materials, promised to the "stagiaires" in Paris by Messrs. Buy, Aubrac and Leblond, was never received.

(It was subsequently explained to us by IS Division staff that, after the signing of the project, it was learnt that most of the equipment to be acquired with project funds had, in fact, already been provided to ERTS Mali in 1972 by USAID, and remained uncrated since. Generally it was thought by the IS Division programme officer and by the consultant

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that the condition of the promises in which equiment would be placed would likely make its provision a waste of money. As to the camera, an expensive Hasselblad being requested - and, according to Bill Bruce, the best for the work - there was concern that it might not last long in the prevailing local security environment and with the recent history of mismanagement of project funds.)

g) Research and Field Activities

The field work consisted of taking samples ("forage") and analysis. The Malians admitted vastly underestimating the time required for analysis. This is not surprising considering the level of familiarity with the various remote sensing techniques at the outset. There is always a tendency, often inadvertantly, to over-simplify the problems involved in image analysis and to over-estimate the potential unique contributions. It was impossible to determine to what extent such expectations were influenced by IDRC's interest and actions leading up to the project.

The field program in general must be considered somewhat limited in effectiveness. While the nature of field activities appears fairly sound, achievement was disappointing. As noted, the reasons given for curtailment of planned field operations were limitations imposed by the project schedule and duration and the lack of adequate ground transport.

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h) IDRC Performance

Robert Leblond paid several visits and they were well received. Everybody remembered, and spoke highly, of his help and understanding (and humour!).

Mercier, Guy of GDTA, and a man called Torez also paid visits. Guy, who was the principal consultant and the person in charge of the training programme, of course visited most frequently.

Diplomatically, it was asked if anybody came from the Treasurer's Office. The first replies were "no". Upon expression of mild surprise by the mission, it was admitted that Pierre Sané of WARO came "after the project completion" on a trip he made "for other purposes".

i) Counterpart Performance

The field work was not completed and the principal reason given for this was that the term was too short. This is explained by the contention that problems appear when you actually do something and they were inexperienced and unable to estimate performance times for something which for them was a new activity. They also commented that organizations like the Centre are "cristallisées" (inflexible) when it comes to considering schedule changes, especially extensions.

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(IS Division personnel have subsequently pointed out some of the decisions of the Centre which, to the contrary, suggest a good deal of flexibility: e.g. S. Diallo going to France to assist in selecting the training institute, S. Diallo participating in drawing up the project schedule, and the re-allocation of funds to permit the record training exercise which was not originally.provided and budgeted for; as to an extension -none was ever requested formally, or considered therefore.)

Specifically, due to factors of delays in receiving imagery and problems in conducting field work, mapping was carried out at 1:500,000 rather than 1:250,000. This represents a fairly significant reduction in effort. On reviewing the outputs of the project, a certain unevenness is evident. It appears that the strong direction of the French in training, research and report writing (viz. the second "stage" in France to compile results) is conspicuous in its absence from subsequent activities.

In general, the map products appear adequate. They are, however, not in a published form which is likely to attract much outside interest. There were promising research possibilities presented by the participants in the field of hydro-geology, a particularly important activity in Mali.

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j) Local Capability

The ERTS Mali bureau has been established since 1970. Physical premises are poor and totally inadequate. Thanks to the IDRC-supported projects there are now two trained people working in it full time and two and one half others who, while currently posted elsewhere, remain available for remote sensing work should the need and resources present themselves.

A brief visit was paid to the "Ecole Nationale d'Ingénieurs" to discuss the curriculum of the geology certificate programme. The Ecole Nationale d'Ingénieurs produces three to five geologists a year and offers courses in 'topographie' (topography) and in "télédétection" (remote sensing). Its largely expatriate staff seems quite competent and there is an active counterpart programme aimed eventually at its full indigenization. The geology programme, on brief examination, appears quite demanding and well balanced. It should produce graduates who, while few in number, could be quite capable.

Although Sine Camara took a little training in "technologie pour le traitement d'images" there is, in fact, no laboratory facilities to carry on this work.

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The Malians consider this project preponderantly a training exercise with the field work, analysis, thematic mapping etc., very ancillary.

What they presently want, now that they believe they have the capability, is a project which would be primarily a field work, analysis and mapping exercise, with training this time secondary.

Two of the four (or five) "stagiaires" are still working in the Direction and comprise the "Bureau ERTS Mali" (which actually was founded in 1970).

At present, the building and other facilities of the "Direction" are totally inadequate for the location of expensive equipment and generally for the carrying out of remote sensing applications beyond the most basic level.

From a cursory glance, the organization, management and administration of the "Direction" is not such as to encourage prospective donors.

The quality of the trained people and their professional interest and keeness, seems of a high order. But they do not seem to have, or do not appreciate the importance of, or do not have the opportunity to exercise, the managerial and administrative skills without which no activity can produce acceptable results. Nor does it seem they may be counted upon from their superiors.

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Evidently, if we are to have projects in countries like Mali, we must devise a way to provide training, guidance and assistance in management and financial administration. In this area, Mali is a wasteland.

k) Clientele and Future Activities

According to the people met in the Direction, a number of ministries are interested in using Landsat imagery, including:

Ministère du Plan:	- for land use planning (e.g. for the recuperation of land previously uninhabited because of onchocerciasis)
Ministère de l'Agriculture:	- land use
	- soil classification
	- crops inventory

There is to be a UNESCO workshop on remote sensing in Bamako in June, 1980.

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USAID will apparently support a substantial project using an independent contractor and Malian counterparts. The object of the project is to map, for the entire arable lands part of the country, precisely what areas are suitable for crops and what crops. As mentioned, we were not able to obtain more information on this project in Bamako. Information could be obtained through CCRS contacts at USAID and the Ouagadougou Regional Remote Sensing Centre.

4. SUDAN

a) Mission Programme

The mission arrived in Khartoum on the evening of November 17 as planned. On the 18th initial attempts to locate the Remote Sensing group by telephone were abandoned in favour of direct contact with the Ministry of Agriculture, Food and Natural Resources. In the afternoon a brief meeting was arranged with Hassan Mohammadi, the Director of the Soil Conservation, Land Use and Water Programming Administration. Also present at this preliminary meeting were Yousif Yagoub, the Manager of the Remote Sensing Unit, and two of the trainees, Yahia I.M. Bushara and Abdelrahim Abdelaziz. The mission was provided with a prepared document responding to the specific questions posed by the IDRC. It is attached herewith as Annex 2.

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It was apparent that there was some ignorance about the mission's schedule. The Director said he had not received the cable giving exact details of arrival and had therefore planned a programme which had to be modified. It was agreed that meetings would be held on Monday the 19th and Wednesday the 21st. Unfortunately Tuesday the 20th was the Islamic New Year and no formal meetings could be arranged. Instead, Mr. Yagoub generously gave up his holiday to conduct a field excursion to an experimental agricultural station approximately 15 km out of Khartoum.

The first general meeting was convened on Monday November 19 and the following project participants were present:

Hassan Modammadi	Director, Soil Conservation, Land Use and Water Programming Administration Ministry of Agriculture, Food and Natural Resources
Yousif Yagoub Mohammed	Manager, Remote Sensing Unit Soil Conservation, Land Use and Water Programming Administration Project Trainee (land use)
Abdelrahim Abdelaziz	Rural Water Corporation, Ministry of Agriculture, Food and Natural Resources Project Trainee (hydrology)
Yahia Bushara	Forestry Administration Project Trainee (forestry)

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Not present were two other trainees, Khalid Ahmed Khalil Ibrahim, who is currently stationed outside Khartoum at Wad Medani doing soil surveys, and Hassan El Sheikh El Bashir who is currently working in statistics at the Ministry of Agriculture, Food and Natural Resources. (The sixth trainee, E. Mardi Hassan is presently working in Cairo.)

On Wednesday morning a meeting was arranged at the National Council for Research (NCR). This body has been mandated to coordinate the establishment (with FAO support) of a National Remote Sensing Centre. In addition to Messrs. Yagoub, Bushara and Abdelrahim who are members of the NCR - sponsored National Council for Remote Sensing, the meeting was attended by:

Saad Abbadi	Secretary General National Council for Research
Abdul Rahman Ahmed El Agib	Director, Council for Scientific and Technological Research (NCR)
Shadul Ahmed Shadul	Geological and Mineral Resources Council
Hassan Mohamed Hasan	Survey Department University of Khartoum College of Engineering

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The purpose of this meeting was to obtain a perspective on the status and future of remote sensing activities at the national level in the Sudan. Much appreciation was expressed to IDRC for its pioneering support in this field, and hope for its continued interest and assistance. The awareness of the extent of general IDRC activities in the Sudan varied greatly among the particpants. The Chairman of the Meeting, Mr. El Agib, noted that his familiarity with this project was minimal since he had been assigned to his current post only two weeks prior to the mission's arrival.

Following the meeting with the National Council for Scientific Research the mission requested an opportunity to discuss in detail the work carried out under the IDRC project. Some considerable time was spent discussing with the trainees all relevant aspects of the project activities. Comments concerning training, methodologies, results and equipment are included as appropriate in the sections of the Sudan report which follow.

b) Project Negotiations

Two factors influenced considerably the negotiation of the project agreement which, in retrospect, had significant shortcomings. It was freely admitted that, prior to the IDRC project, there existed little or no indigenous familiarity with remote sensing activities.

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This, of course, made it difficult for the participants to adequately estimate the nature and extent of contributions and goals which would be appropriate and realistic on the part of either donor or recipient. One must reflect on the possible circumstances which lead to the submission of a proposal to IDRC in an area where no prior experience or even familiarity existed. The project discussions started from ground zero. Recognition of this factor is therefore critical in evaluating the achievements, and particularly the weaknesses, of the project. Accepting this apparent lack of prior involvement in remote sensing it is curious that, from 1972, the Sudan was selected for relatively intensive efforts by NASA to obtain maximum satellite image coverage. It is likley that these efforts were almost entirely expatriate endeavours and this could explain the lack of domestic interest and involvement.

The second major source of difficulty is without doubt a common one and arises from the recipient's seemingly hazy grasp of the philosophy, interests and method of operation of the IDRC (which, given the relatively large number of IDRC projects in the country, might be expected to be better). In usual circumstances a recipient is reluctant to risk making specific requests which may be outside the donor's interests, or conversely questioning donor decisions or recommendations

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which may not be totally acceptable, or even refusing something which is offered although it may not be needed or even wanted. The problem is obviously compounded when prospective recipients deal with an agency like IDRC which is "responsive" rather than arriving at a recipient's door with a kit of things which it "does". As will be noted, these factors help to explain certain misunderstandings and inadequacies in the areas of recipient contribution and approach to technology transfer.

At one meeting, we asked the participants, knowing what they know now, what they would ask for if the project were being initiated today. The list included: buildings, more equipment (unspecified), more training (of technicians as well as professionals), vehicles, a photo laboratory and funds to assist the promotion (through seminars, etc.) of remote sensing in the country with ministries and services which should use it.

c) Project Schedule

The project was formally inaugurated in early June 1975. It comprised two principal operational elements. The first was the training of resource specialists. An agreement was reached with Purdue University in October to train six people during a three month course. The training phase, which took place from March to October 1976, and was

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under the charge of M.F. Baumgardner, also included the production atPerdue of 1:250,000 Landsat computer classifications for the 180,000 km^2 study area. Following the completion of training at Purdue the particpants visited the EROS Data Centre in Sioux Falls, South Dakota and the Canada Centre for Remote Sensing in Ottawa.

The second element, the field investigations and the preparation of thematic maps from the classified Landsat imagery provided by Purdue, began on the return of the trainees to the Sudan. Dr. Baumgardner visited the study area in late November 1976 for one month to evaluate and assist in this process.

Following a visit by R.Leblond in March 1977, financial and equipment acquisition details were completed. The project was concluded in January 1978.

d) People

Hassan Mohammadi, from the mission's limited contact with him, appears to be alert to his nation's problems and the role of his organization in their treatment It is also evident that his energies are so monopolized by administrative demands that he can have little left for setting goals and policy and for technical participation. Thus,

although he is familiar with the IDRC sponsored activities and genuinely appreciative of the important opportunities they provided, his grasp of the techniques used appears superficial. Mr. Mohammadi was most generous and cooperative in his reception of this mission. It was obvious that he felt the mission warranted preparation and his personal participation.

Yousif Yagoub, the manager of the remote sensing unit, was also one of the project trainees. Mr Yagoub appears competent in his field of Land Use and interested in the application potentials of remote sensing. His abilities in the role of manager, from our limited contact, were much less evident. There appears to have been little before to sustain internal activities or consolidate available equipment and expertise in a productive manner.

It was emphasized what a problem it is to keep trained people together to do remote sensing work when such work must, at this time, be mostly externally funded and there is no present funding (except FAO support for the Remote Sensing Centre).

Yahia Bushara, a forester, was particularly impressive, both in terms of his discipline expertise and his ability to relate forestry requirements to the Remote Sensing technology which was available to him.

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Mr. Abdelrahim Adbelaziz, a hydrologist, was somewhat unforthcoming. He was, therefore, less communicative but, upon direct questioning, showed competence and interest.

Mr. E. Mardi Hassan, a geologist and another trainee, was not available for discussions but is mentioned here as he is the participant who continued on to enroll in an M.Sc. program in Purdue. It was reported that he has completed his degree and is currently working in remote sensing on a cooperative Sudan-Egypt project in Cairo.

e) Training

The training was carried out at Purdue University in Indiana. In retrospect, the selection of Purdue must in some ways be seen as inappropriate. In the view of the trainees, they were not presented with a choice of training programmes, nor, it must be said, if they had would they have been able to make an informed selection. Early in the training it became obvious that the overwhelming emphasis at Purdue on computer processing of Landsat data, though perhaps useful in absolute terms, was not appropriate to Sudanese needs, facilities and capabilities. As the trainees put it, they were training for possibilities which did not exist at home. In response to their

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request a small amount of effort was eventually placed on visual interpretation (a critical capability to which, it must be remembered, the trainees had had no previous exposure). It was only during their visit to the EROS Data Centre in Sioux Falls that the trainees realized that such visual interpretation courses could be available. However, as the next course was fully booked and about to start, the trainees returned to the Sudan before a request was made to IDRC to expand the training component to include such a course. This request was subsequently turned down by IDRC, presumably due to the cost of six return air tickets to, and training courses in, the United States.

The inappropriateness of the training to the circumstances of Sudan was to have significant implications on the conduct and results of this aspect of the project. The trainees could give no explanation for the selection of Purdue other than the fact that the Purdue group was doing work in the Sudan at the time of the IDRC interest, though not involving any Sudanese. Undeniably experience in the Sudanese environment was a valuable asset offered by Dr. Baumgardner. However, the ability to assess and provide access to appropriate technology is of overriding importance. Purdue was apparently not in a position to provide such access, with results which will be considered later.

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The outcome of the training, inspite of the question of appropriate emphasis, was far from totally negative. It is significant to note that this exposure to the technology, together with the trainees' discipline expertise, allowed them very quickly to perceive the level of technology which was appropriate in their situation. This perception is a considerable credit to the participants and deserves mention.

f) Equipment

It was reported that most equipment and materials to be provided by the projecthad in fact been received. On the general theme of equipment the Sudanese expressed appreciation for the confidence placed in their organizations by equipment local management of finances including purchasing. However,they noted that in practical terms it is very difficult for them to purchase equipment from outside the country. Once hard currency is converted to local currency it is almost impossible to re-convert it. It was for this reason that IDRC was requested to make equipment purchases directly.

Generally, the choice of equipment provided was good. However, since the training was computer based, and the equipment analog based, it is evident that it is not being utilized as fully as it might.

The equipment has not yet found a permanent home. Its current temporary location, in space soon to be occupied by the Institute for Environmental Studies at the University of Khartoum, is adequate (and far superior to the premises provided in Bamako). The equipment was moved from its former location where the building was taken over by a different function. The final intended location is at the Forestry Department where the National Remote Sensing Centre is to be located. The current location served to make the equipment available for the USAID sponsored course. The two major pieces of equipment, the colour additive viewer and zoom transfer scope, appeared well looked after and free of evidence of careless or rough treatment. It should be noted, however, that the equipment had been put into service in September by a technician from the University of South Dakota. This suggests that such "set-up" was necessary before the equipment could be used at all. In fact the Sudanese mentioned that the equipment arrived with no set-up instructions and their technician experienced some difficulties which were not overcome until the arrival of the expatriate technician in September. We got the distinct impression that the equipment had been used little, if at all, since the USAID/South Dakota seminar later referred to.

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In future, it would be wise to include provisions for adequate set-up both in selecting and purchasing major equipment. Equipment purchases of has type must also include an adequate spares kit. Most manufacturers can provide such a kit. No such provision was made in the case of the Sudan so that the colour additive viewer has been functioning at less than ¾ efficiency due simply to a burnt out temporary lamp and it is likely impossible to obtain a replacement at the present time from within the Sudan. These factors of equipment suitability, set-up, and spares are factors which, if not considered, will undoubtedly soon jeopardize the whole equipment investment. Under the conditions observed in most of Africa, a piece of equipment in need of minor repair, if not repaired immediately, can become unrepairable in a disturbingly short time.

g) Research and Field Activities

Although the project, as in the case of Mali, is properly regarded primarily as a training and technology transfer exercise, the demonstration phase necessarily involved a degree of research oriented activity. In this context, field activities were a vital component; necessary to calibrate, verify and extend the results of remote sensing based activities. Upon receipt of standard Landsat imagery of the study area the project staff, through interdisciplinary consultation and field checking, were able to conduct a preliminary image evaluation. This preparation was to serve as background for the image analysis activity later carried out at Purdue.

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Following the return to the Sudan after training, initial field checking confirmed the participants' belief that considerable revision of the computer mapped land classes would be necessary. From discussions with the participants, it appears that approximately 10% of the area was field checked as an adequate sample. The site selection for field checking was based upon two criteria. The first was necessarily accessibility. This was combined with evaluation of large scale black and white reproductions of the imagery to identify "type" areas, transition zones and areas of potential confusion for specific field investigation. The classified imagery was not found useful at this stage because of the loss of detail inherent in the process. The field data obtained through traverse sampling was combined with visual interpretation to produce a map product against which to compare the computer product. In each of the discipline areas a composite map was produced which is in fact an interpretation of the computer classified image in light of field experience and visual evaluation of textural and pattern information not readily available from the classified product.

The participants concluded that, although the computer classified image yielded units of certain bio-physical relevance, it must be interpreted by each specialist to extract information of direct resource relevance. The participants acknowledged the utility of the computer techniques but only as a supplement to visual image analysis and ground investigation.

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They expressed regret that their limited competence in visual interpretation presents the major limit on the utility of the data. They pointed out that computerized techniques are currently not available or appropriate for application within the Sudan. Mr. Abdelaziz subsequently participated in a specialized image interpretation course in hydrology at the Nairobi Regional Remote Sensing Centre, which he found useful but too brief for the detailed operational training necessary. (In Nairobi USAID is supporting remote sensing activities which are located at the ECA Regional Centre for services in surveying and mapping.)

It should be noted that the final mapping was based primarily on Landsat derived data. The participants recognized the weakness of dependence on a single data source but work under conditions where little or no supplementary or complementary data is available and there are no resources to collect it.

The maps shown to the mission were manuscript copies. They have not been formally reproduced or issued. Their value lies primarily in the learning experience they represent. They do, in addition, provide resource evaluation information which is of use internally and has attracted external attention and interest on the part of other Ministeries Such mapping could not be extended to other areas in its current form due to the unavailability of the computer classified data. The mission would not recommend that such extension be encouraged as long as internal capabilities are inadequate to permit full participation.

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h) IDRC Performance

The participants expressed satisfaction with the professional support provided by the IDRC. R. Leblond's visits were most welcome and useful. In view of their lack of familiarity with the technology to which they were exposed at Purdue, their request for extension of on-site consultant activities is not surprising.

When we asked if management support would have been welcome from the IDRC, there was total silence. We gathered it would not be welcome, which is not necessarily the same as not useful or needed.

As noted earlier, while vehicle support we were told was an item which could have been financed internally by the Sudanese, they at the same time recommended (in their written report) that IDRC should have purchased vehicles to facilitate field work. The unsatisfactory vehicle arrangement was admitted by the Sudanese as being their fault.

The Sudanese apparently requested more equipment and an additional month's training, the funds to come from the field investigation and vehicle expenses portion of the budget, but the request was refused. They seemed to be surprised at this, and not sure why.

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IDRC's policy of working through, and thereby strengthening local institutions was praised. It was felt and stated that individual projects, independent of local institutions, tend to die upon completion.

i) Counterpart Performance

The support provided by the Sudan, for the most part, appears to have met the spirit of the agreement. The occasional discrepancies have plausible explanations. Problems of inflation were cited as having severe impacts. It was noted that a request for transfer of funds from "vehicle support" to "equipment" and "training" was not accepted by IDRC. The Sudanese justification was that they knew that Sudan could provide the vehicle support from the beginning from general budgetary resources but that, since IDRC offered it, the offer was accepted in the spirit that it represented a larger budget which must be available and useful at a later date applied, if necessary, elsewhere within the project. One was struck and impressed with the honesty and frankness of this explanation which is quite understandable in real world terms.

There was, however, some contradiction on the point of vehicle support since it was also mentioned in the Sudanese written response that vehicle breakdown and the unavailability of spare parts adversely affected the field programme There is clearly no simple solution to this problem. It is simply raised as a concern expressed by the participants and one which can have had a significant effect on the conduct of the project.

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j) Local Capability

Sudanese interest in Remote Sensing began as early as 1972. The IDRC-Sudan project represents, nevertheless , the first substantive effort on the part of the Sudanese themselves to participate actively in the utilization of remotely sensed data. While no formal, self-sustaining programme even yet exists, the participants in the project represent a nucleus of basic expertise with sufficient knowledge, experience and confidence to tak a lead in expanding the initial technology transfer programme to one of technology expansion and diffusion. The basic limitation which must be recognized is the inadequacy of training in those low technology approaches to Remote Sensing which are most appropriate for use in the Sudan.

Post-project evidence of continued and expanding interest and involvement in the use of remotely sensed data is apparent. Provided adequate support is forthcoming from external sources, internal efforts have the technical potential for significant impact on resource evaluation in the Sudan.

The Remote Sensing group trained through IDRC support is not consolidated administratively, aside from Messrs. Abdelaziz and Yagoub, but theoretically can be called upon for joint participation on a short term basis. There seems no intention for the present to seek any more formal integration. The former project trainees have most recently combined

efforts as demonstrators in a training course and symposium held in Khartoum in September 1979 which 30 people attended. These activities were coordinated by the University of South Dakota under USAID funding. The IDRC provided equipment figured prominently in the programme. These activities were reportedly well attended, useful and generally well received.

k) The Clientele and Future Activities

The IDRC sponsored project in the Sudan has provided the basis for a broadening range of contacts and interests in the Sudan.

The process has led to the establishment of a National Committee for Remote Sensing and appears likley to culminate in the establishment of a National Remote Sensing Centre under FAO sponsorship.

The proposed National Remote Sensing Centre's needs include, but go far beyond support for, research activities. Any consideration of further IDRC involvement must certainly consider FAO's plans and experience here. At present the degree of real inter-ministerial coordination and cooperation is not clear. While there seems a general desire to support a national facility where expensive equipment and specialized expertise would be concentrated, there is also an evident desire to maintain and

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even develop other Remote Sensing programmes, facilities and expertise in various ministries. While this should not be regarded necessarily as a negative situation, the realities of future coordination and the risk of duplication and waste, in the national context, should be carefully assessed by a donor contemplating support.

Specific instances of post-project research interests include:

- Ministry of Agriculture Food and Natural Resources: soil survey, Kordufan Region

- Egyptian Remote Sensing Centre: cooperative research in the areas of geology and water resources

- A National Resources Inventory: principally to assist food production. The country is mapped twice a year by Landsat imagery. In the Sudan there are reportedly 10 million acres of arable land but it is needed to know precisely where, how much exactly and for what crops might particular land be suitable. The last vegetation map of the Sudan dates from 1958 and only 10% of the country is considered presently adequately mapped.

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- Six Year Plan: The present (or next ?) six year plan provides for remote sensing training and two complete mappings of the country. But it is doubted if the resources could be available for this ambitious programme.

- Desertification: It is hoped, using remote sensing technology, to monitor desertification and to do research in determining the source of this problem (the problem is common to many countries but the nature and rate are special to particular areas).

However, it is apparent and confirmed by Mr. Mohammadi that few, if any, research activities in the Sudan, in any field can legitimately be said to be self-sustaining without outside support. In fact, allocation of available internal resources is often made in consideration of a programme's potential for success in attracting foreign support. Therefore, the question of this activity's viability measured in terms of evidence of sustained internal support, becomes rather unrealistic and academic.

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5. TANZANIA

a) Mission Programme

Price and Bruce arrived in Dar-es-Salaam as scheduled on the morning of November 22. The mission was met on arrival by Dr. Bruce King ODM/BRALUP. After an overnight flight, mercifully only a brief meeting was held that day to fix the programme with BRALUP (Bureau of Resource Assessment and Land Use Planning), the project executing agency and a part of the University of Dar-es-Salaam.

On November 23 the mission met at BRALUP with Dr. Adolfo Mascarenhas (Director of BRALUP and Rukwa Project Leader), Dr. Bruce King (expert provided by ODM to BRALUP), Idris Kikula and James Ngana (Rukwa Project Participants and IDRC trainees) and Sitna Mohammed (recent addition to BRALUP Remote Sensing team). The third trainee, from the Serengeti Research Institute, Feroz Khurji, is no longer associated with the group. His departure is variously attributed to dissatisfaction with the emphasis of the project and general malaise at the Serengeti Institute.

Due to a BRALUP review in progress at the time of the mission (instigated by SIDA, its principal donor) no meetings were possible on Saturday, November 24. The free days were used to prepare preliminary drafts of the mission's reports for Mali and the Sudan.

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On Monday morning, November 26, the mission inspected facilities of the Department of Surveys and Mapping, which is beginning to cooperate in Remote Sensing, and of BRALUP. Extensive discussions were held later with the project trainees. A review meeting was held with the project staff at BRALUP on November 27 to complete the mission's activities in Tanzania.

b) Project Negotiations

IDRC's interest provided the first opportunity for BRALUP (and Tanzania) to become involved in the use of Remote Sensing in an organized way.

At the time of the negotiations, BRALUP's goals and responsibilities towards the Rukwa region appeared to have been fairly well established. BRALUP had been asked to prepare the "Rural Integrated Development Plan" (RIDEP) for the remote Rukwa region, one of twenty such regions in the country. The preparation of RIDEP's for all the other regions had previously been accepted by various external donor agencies (including CIDA). But Rukwa, principally because of its remoteness, was not attractive to these agencies.

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This factor, combined with the near complete lack of information on the region, led the BRALUP team to consider the use of satellite imagery for the resource mapping and analysis which were an important element of the plan. It was at this point that IDRC offered to make its support available.

From BRALUP's point of view, the project had to meet two goals:

- To meet immediate government requirements for the Rukwa "RIDEP" to which BRALUP was committed.
- To establish a solid basis for future research in the application of remote sensing to resource inventory

BRALUP therefore envisaged three components to their project:

- first and foremost, to embark on the application of the technology for the Rukwa RIDEP;
- to obtain essential training to accomplish the immediate goals;

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- to support the BRALUP mandate to promote the use of remote sensing in certain dvelopment sectors, paricularly planning.

There seems to have been no significant misunderstandings arising from the negotiations.

c) Project Schedule

The IDRC - Tanzania Rukwa project was accepted in late May 1976. Prior to commencement of training, preliminary field work and image analysis were carried out in Tanzania. Three Tanzanians received five months of training at Laurentian University under the direction of Dr. Roger Pitblado. Following the training, work began on the operational mapping component of the project. This phase included at least four months of field work divided among several groups and individual safaris. The orders for equipment were placed upon the completion of the training.

At this point in the project, a series of delays were encountered These necessitated an initial 13 month extension of the termination date to the end of May 1979. During this period of this extension it should be noted that the original principal investigator, Dr.

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Mascarenhas, was in Geneva on a UN agency assignment. Dr. King was fortunately available to take over his project responsibilities. Had this substitution not been possible, the impact on the project of the project leader's absence would likely have been disastrous.

The IDRC further agreed to extend the termination date until the end of August 1979. At date of visit, however, the project was still not considered officially terminated.

d) People

Dr. Mascarenhas created a most favourable impression on the mission. He is clearly a scientist of considerable intelligence, a careful planner and able to make things work about as well as anybody in the context of Tanzania. That he somehow appears to maintain an island of relative order and direction in a sea of chaos attests to his abilities. Unfortunately, such a valuable commodity is in high demand and the calls upon his time obviously exceed the hours in the day. Even though administrative demands must severely limit his ability for personal, professional, project involvement, it is apparent that he enjoys the respect of his staff on both a personal and professional level.

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Dr. King seems a competent, realistic, highly motivated and patient individual. He appears to work and communicate easily with his African colleagues. A strong character, he has clearly exerted a somewhat dominating influence on the development and orientation of ideas. Although in some respects this can be seen as a negative factor (he does so much himself), the fact that his influence is largely sound and positive makes such criticism on principle rather difficult. He is in the classic expatriate predicament in Tanzania - if he doesn't do it, who will?

One does not care to reflect on the future of BRALUP should either or both of these individuals leave. The case of BRALUP certainly provides graphic evidence of the importance in the African context of that valuable , essential, commodity - leadership. One is also forced to recognize the extent to which the potential and success of any endeavour are dependent upon it.

Idris Kikula and James Ngana are both competent professionals in their respective fields with the confidence necessary to be inquisitive and innovative in new fields which are relevant to them. Their respective research activities at the master's level are sound and encouraging. Although both are communicative and express themselves clearly, Mr. Kikula has the advantage of greater experience. He prepared maps of the major physio-economic types of the Rukwa region and monitored changes

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in vegetation, while Mr. Ngana up-dated the hydrology map of this region. These two men could no doubt find attractive positions virtually anywhere that expertise in remote sensing is in demand. Although Dr. King's influence is clearly visible, as noted previously, the nature and effect of this influence make it difficult to criticize except rather shallowly.

Sitna Mohammed was not a participant in the IDRC project. She received some training through the FAO programme which is referred to in the project file and has been working on the preparation of soils maps. Upon completion of her graduate program in pedology, it is intended that she will join the BRALUP staff as part of the remote sensing team. This is noted primarily as tangible evidence of BRALUP's apparent commitment to the expansion of remote sensing activities as a result of the IDRC support.

e) Training

The training component of the project was planned for the period January to May 1977, and was conducted at Laurentian University, Sudbury, Ontario. In this regard, IDRC contracted for the services of Roger Pitblado and Gerald O. Topper. Mr. Topper was responsible for the bulk of the basic remote sensing instruction while Dr. Pitblado treated digital processing and took charge of on-site investigations. Mr. Mascarenhas informed us that Dr. Pitblado had been on the BRALUP staff for two years and that his familiarity with Tanzania was a factor in his favour.

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Laurentian University in some ways was a rather surprising choice in 1977 among other Canadian institutions. The University is not particularly known for its programme or activities in remote sensing. Nor are the faculty among the more intensively involved in the field in Canada. The BRALUP people feel that the selection of Laurentian may have been a Canadian "political" decision although influences which might have been brought to bear were not explained and (if any) are probably not known. The comment is simply passed on here for whatever it may reveal of people's thinking.

It is apparent, through discussion with the trainees, however, that the training was in most respects satisfactory. Dr. Pitblado was especially complimented for his constant concern for the well being of the trainees. It was noted, by the trainees, that although the course treated all areas of the technology there seemed to be a basic philosophical conflict among the faculty as regards the relative merits of visual and computer techniques for image analysis. It is apparent that, as is all too often the case, these approaches were treated as mutually exclusive. The problem is exacerbated for the trainees when trainers are divided amongst themselves.

In retrospect, it appears that Dr. Pitblado, like most people at the time, was not himself sufficiently experienced with the digital analysis techniques to be totally realistic in his expectations. The fact that the trainees did not participate significantly in the conduct of the analysis is a serious omission as their involvement and local knowledge could no doubt have contributed to a more positive

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analysis. Considerable time and effort was spent by the trainees rather unproductively attempting to use questionable and unfamiliar computer output in isolation from other possible approaches. Only on return to Tanzania was a more realistic integration of these approaches made. Dr. King's practical (though perhaps somewhat restricted) evaluation of the role of digital analysis facilitated this partial adjustment. The basic limits imposed by the isolated manner in which the initial computer classification was done, undoubtedly placed the ultimate limit on utility.

The authors wish to stress that these above comments are in no way intended as a specific criticism of Dr. Pitblado or the Laurentian programme. The criticism rather is of the state-of-the-art of computer image analysis in 1977. This technology is evolving very rapidly. At that time, although the technology of data processing was very sophisticated, general knowledge of how to apply it realistically and constructively almost universally lagged.

Had the digital analysis been undertaken today, it could have much more usefully applied. In general, the training programme,while not likely among the best available in Canada, was quite strong and demonstrated a commendable balance which clearly helped provide the BRALUP trainees with a broad and flexible preparation for their future work.

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In a general way Tanzania prefers training in the country under local conditions, going outside only for occasional seminars. The Tanzanians were highly complimentary about the good organization and usefulness of the Nairobi workshop.

f) Equipment

The major pieces of equipment are in good condition and installed in excellent facilities in the BRALUP building. They are soon to be moved to a new wing of the building which will be devoted exclusively to the remote sensing programme. The colour additive viewer is used extensively and is well maintained. The densitometer is of somewhat limited utility at present but has been used by Steven Kajula, BRALUP's well trained and competent photo technician. This piece of equipment will be much more intensively used if BRALUP suceeds in obtaining support for a much needed photo processing laboratory which would be under the direction of Mr. Kajula. The capability to do research on photographic image production optimized to the local environment would be a significant step toward the development of a very valuable indigenous expertise and capability. Initial experiments in image reproductionsin cooperation with the Ministry of Surveys are most encouraging considering the facilities available.

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Foreign exchange being in very short supply, it is difficult to buy things outside, including satellite imagery. This partly explains BRALUP's wish to build and operate its own photo processing facility.

The Director is most anxious to install a facility which will be able to print the high quality coloured maps which he feels are important to persuade people, and especially those at high levels, of the importance of something and to mobilize action. The excuse to create another mapping service is that the government mapping office is slow and inefficient and cannot deliver and, most of all, it cannot be expected to produce the thematic maps which BRALUP particularly needs.

g) Research and Field Activities

With the exception of final map production, clerical and support activities, the project work undertaken by BRALUP was carried out by the trainees.

The approach adopted for the use of remote sensing was to consider the image products as only one (albeit very important) data source which might be used in the work. The research and image interpretation activities seem to have been well supported by field work. The mandate given to BRALUP to carry out the Rukwa RIDEP obviously contributed to the completeness with which the work was carried out. In other words, it was clearly in BRALUP's best interest that the work be thorough, complete and competitive with similar RIDEP projects being carried out elsewhere by others.

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The research team found the computer classification output to be useful regionally but of limited relevance in detail. Most of the final interpretation relied on visual techniques. Examples of computer enhanced imagery obtained late in the project were deemed to be of great value compared with standard imagery. This latter assessment would be almost universally supported.

It was noted that, since the Laurentian laboratory had little in the way of equipment, some time was required to fully appreciate the capabilities of the equipment acquired for BRALUP. In future, these will be used more extensively in research and operational work.

h) IDRC Performance

There is little doubt that the nature and extent of IDRC support to BRALUP was timely and appropriate. BRALUP particularly appreciated the IDRC approach which encourages direct, professional dialogue between donor and recipient agency. The understanding showed by IDRC in agreeing to take over responsibility for equipment purchases was particularly appreciated. Although there was a reluctance to criticize the consultant in view of his largely positive contribution, it was noted that, in spite of his Tanzanian experience, someone with greater practical experience in the application and integration of remote sensing in resource inventory would have been more appropriate.

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It was felt that IDRC should have been more aware of Tanzania's limited capability to produce thematic maps and provided more assistance, both technical and financial, here.

It was expressedly mentioned by the Tanzanians that they were never informed how much of the IDRC administered portion of the budget was spent, nor how. They obviously feel that they should be informed by us of this and that, in particular, they should know if there is any money left over and consulted on how it should be spent.

The computer tapes are apparently still at Laurentian with Dr. Pitblado while the Tanzanians feel they should be held at IDRC on their behalf.

In common with the other projects visited, the Tanzanians feel that the project was too short.

While a vehicle was not requested or offered, it would have been very useful at the field investigation stage.

The question of how active IDRC should be in a project is a delicate one. The line between essential assistance and inhibiting interference can be very difficult to draw. Likely its perception would vary between IDRC and the recipient. In general, IDRC's fairly trusting policy is respected. One must consider, however, if somewhat closer interaction

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on such performance matters as narrative and financial report submission might not have the secondary benefit of improving management practices in the recipient agency. Once an atmosphere of trust and respect is established, the opportunities for positive reinforcement are greatly increased. IDRC is widely felt to be a positive influence. If properly executed, somewhat closer performance evaluation need not risk any real loss of esteem in the eyes of recipients.

i) Counterpart Performance

By virtue of its organization as a research bureau within a university, BRALUP is in a favoured situation to undertake sponsored project work. Considerable human resources can be devoted to the work since the participants use projects for their post-graduate field studies. At the same time, the Bureau possesses a professional staff which is involved primarily in operational research.

If any deficiencies can be recognized in BRALUP's support of the project they can be attributed to the relatively high activity level at the Bureau in general This is particularly the case of the Director. It is obvious that, in a country conspicuously short of both, his energy and competence have inevitably lead to overcommitment, a situation which is unfortunate for the individual involved, and almost inevitable.

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BRALUP offered an interesting variation on the continuing theme of vehicles. Although a vehicle was not requested, it was stressed that in Africa adequate ground transport is often the determining factor in a project's success. Whereas at the time of the IDRC project, vehicles were fortunately available at BRALUP, Mascarenhas stated that now the provision of necessary vehicles has virtually become a prerequisite to accepting any project.

It appears that the final term extension has primarily necessitated by delays in completing the required thematic mapping. Initial enquiries by BRALUP determined that maps of acceptable quality could not be produced in Tanzania, at least not in a useful time. Professor Mascarenhas advised that the production of high quality colour map products would mean the difference between a product which would be scientifically valid but largely ignored and one which could influence planners and decision-makers. On this point the mission can only recommend that Professor Mascarenhas' experience with Tanzanian authorities probably justifies his decision to have the maps produced outside the country, although if this practice is to be commonplace this assertion, costs and alternatives should all be closely assessed. The maps eventually were prepared at Clark University, with which BRALUP has had previous association, and from unexpended funds available in one of its project budgets. As a result of this maps of excellent, if somewhat luxurious, quality are now available.

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At the time of the evaluation, the particpants had not yet submitted the terminal narrative and financial reports required by IDRC and requested by the comptroller in a letter dated April 9, 1979. Although a manuscript has reportedly been prepared, Professor Mascarenhas was reluctant to set a date for submission of the final report. Now that the project, as it concerns BRALUP, is largely over with their goals being satisfactorily acheived, it is not difficult to understand the situation which has developed. Although the report is a relatively minor effort, the director's activities are undoubtedly directed to the vital problem of securing future external support for the Bureau's activities. The excuses given were that there was a delay in having the maps prepared by Clark University and that the University of Dar-es-Salaam's Bursar's Office is slow and inefficient. Mascarenhas expressed the hope that BRALUP might soon be granted the status of Institute (independent of the University). Such a change would permit, among other things, more independent financial management and operation. The participants were advised that not only is the report a requirement of IDRC, but its prompt submission would create a more favourable impression of BRALUP's management capabilities. Raising the subject caused some embarrassment all around.

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j) Local Capability

Substantially due to the IDRC initiative, a centre of remote sensing expertise now exists within BRALUP. After the experience gained in the preparation of the Rukwa RIDEP, the BRALUP team appears to have established leadership in the application of remote sensing to resource evaluation in Tanzania. In fact, it feels that in three years, working the Rukwa project, it produced a product which may serve as a model for land resource analysis for the whole of Tanzania. BRALUP has undertaken an extensive program of information dissemination and technology transfer throughout the ministeries. As a result, considerable interest appears to be developing concerning the potential for the use of remote sensing techniques in situations where data is lacking and is too costly or time consuming to obtain by other means.

It goes without saying that BRALUP, like any other centre of expertise in developing countries, is very vulnerable in terms of depth of personnel. At the present time at BRALUP there are only three Tanzanian Ph.D.'s, six other Tanzanians who are considered "in training" and five expatriates - a Ugandan, a Dutchman, a Norwegian, a Dane and Dr. King who is British. It will take a number of years of steady development and support, both internally and through the action of outside funding agencies, to insure the development of a sufficient number of trained professionals who can provide the full range of essential technical knowledge and services.

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k) The Clientele and Future Activities

NORAD and DANIDA are funding projects at BRALUP which will use remote sensing. BRALUP is firmly established as the centre of excellence for, and coordinator of, remote sensing in Tanzania. Most of the new wing will be devoted to remote sensing activities and, if funds can be found, it is intended to install both photoprocessing and map producing facilities.

It is hoped to obtain further support from the IDRC for these activities but for what specific work, and when a request might be received, is anybody's guess. A number of ministries, especially the Ministry of Water, Energy and Minerals, have shown interest in the kind of maps, especially thematic maps, which BRALUP has been able to develop using remote sensing technology and have indicated they would be willing to pay for such a service were it available.

The Norwegian Water Resources Information Planning team is using remote sensing data.

The activity has the support of the Tanzania National Science Research Council and a coordinating body, (the National Remote Sensing Advisory Committee), charged with directing training, disseminating information and organizing workshops, meets every six weeks.

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Unfortunately, at least in the view of BRALUP, the Ministry charged with being the ministerial focal point for remote sensing is the Ministry of Agriculture rather than as heretofore and more logically, the Ministry of Water, Energy and Minerals (these may not be the precise names of these ministries).

Robert Leblond, in his account of his March 1980 visit to Tanzania, reports that ministerial responsibility has reverted back to the Ministry of Water, Energy and Minerals).

Apart from a few with Mozambique, and some communication with the ECA/USAID sponsored remote sensing unit in Nairobi, there are few regional contacts at the present TIME. The Tanzanians feel, however, that for the time being Mozambique, and such other neighbouring countries as Rwanda and Burundi, would be better off going to Tanzania than to North America and Europe.

C. COMMENTS, CONCERNS AND FACTORS COMMON TO THE PROJECTS

1. No project had received the report of the Nairobi workshop. As the meeting was held in March 1978, this seems a noteworthy ommission. IS Division explained to us that the delay was in authorization to release the report rather than in its preparation. On the other hand, we understand that each project was to submit to the rapporteur

its report on the workshop and it seems that none of the African projects which we visited actually did. We left, with each project, three copies of the report which was appreciated.

2. All projects were emphatic that the time allowed to do the project was too short. Yet several seemed to have actually accomplished what work they did do in fewer months than the figure allotted in their GCL's. This we presume is accounted for by delayed starts after acceptance which necessitated shortening the term in order to conform to the GCL deadline. The part of the projects most reversely effected by the short project terms was the development of what might be called the 'product' - maps, information, etc.

3. All African projects felt that the IDRC was somewhat secretive on budget matters. The recipients' understanding was that, once the projects were approved, the money became in effect theirs, and that the IDRC should have been more candid and forthcoming in discussing unspent balances, amounts available, expenditures, etc. They all think that the projects terminated with unspent funds which should have been made available to them to continue project activities. Projects also complained of delays in the actual remittance of funds and we assume that, if in fact there were delays, they were in part due to formalities and GCL conditions, for the payment of installments, not being satisfied by recipients.

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4. The training was generally not appropriate for domestic realities, e.g. digital analysis when there are no facilities in the countries to do this type of work.

5. Too little time of consultants was provided. Consultants should have visited more often and, on each visit, for longer periods.

6. There is no significant national budgetary financial commitment in any country to support substantial remote sensing activities. It is new technology, transferred from outside and in the medium term, to survive, it must continue to be funded from outside. Its importance is recognized at the professional and even at the policy level, but this recognition has not yet managed to attract funding from indigenous resources. So the IDRC's hope that it provides seed money to get something started and that, once started and the usefulness established, national resources carry it on, is certainly precocious here and probably generally where new technology is introduced by outside donor agencies. Our hope and theory are undoubtedly rooted in our assumption that, as countries develop, they have more human and material resources from which they can draw to carry on endeavours started by outsiders. Unfortunately, in most LDC's these resources do not seem to be developing fast enough even to look after expanding needs in traditional sectors, let alone permit taking on new ones. The poorest

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countries literally lurch from project to project, for both priority and secondary needs.

7. Recipients felt that it was totally out of the question to expect their purchasing services to make equipment acquisitions for outside donor funded projects. They simply do not have the facilities, systems and abilities to make choices, obtain prices, place orders and arrange deliveries. That IDRC understands and accepts this (unlike some agencies, notably CIDA) is much appreciated. With equipment should come spare parts, setting up instructions and, where necessary, expert setting up assistance.

8. At least in the three African countries, map production facilities are primitive, inefficient and generally inadequate.

9. The Nairobi workshop, bringing together people from all the projects and resource people, was considered by all participants as a most instructive and generally useful exercise.

10. IDRC was criticized as being rather rigid when it came to considering itself making equipment and vehicle purchases, budget alterations, term extensions, training supplements, etc.

11. There was general difficulty in negotiating an appropriate project agreement with a relatively unknown agency for an activity involving an almost totally obscure technology.

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D. CONCLUSIONS AND RECOMMENDATIONS

1. The projects achieved their training objectives except insofar as too much of the training was in remote sensing techniques for which there are no adequate facilities in the countries in question. More training in visual, rather than digital, analysis would have been more appropriate.

   Analysis and thematic mapping fell significantly short of objectives for which a number of reasons were given shortage of time (principally), lack of ground transport, inappropriateness of training, poor local map production facilities, seasonal factors, etc.

   It should be emphasized that all projects considered the training aspect as the most important part of the projects, with the analysis and mapping complementary.

2. The projects were all located in countries classified as the very poorest and the human, institutional and financial resources of which were therefore extremely limited. Given this reality the objectives, in the time allotted, were not realistic and achievable. The project terms should have been longer in all cases, ground transport arrangements should have paid more attention to local realities than to Centre general policies and probably there should have been more on site visits from resource people and general administrative and financial support.

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Here, perhaps, it should be noted that, in the mid seventies, when these projects were being considered, expectations of the new Landsat technology were commonly over-optimistic. Expectations have been more realistically scaled since. Similarly, what a poor country could do with the technology, and the kind of support which would be necessary to transfer it, was consequently underestimated. It is relevant to ask if many developed countries could have done much more with the money, and in the time, allotted to these projects.

3. The projects have certainly developed scientific personnel. We met most of the trainees in Mali, the Sudan and Tanzania and were uniformly impressed with their knowledge, interest and enthusiasm for the technology and its potential for development uses. The majority were still involved indirectly in remote sensing work and the others were reported to be accessible if required.

We would rate the effectiveness of the three training programmes in the following order: GDTA (Mali), Laurentian (Tanzania) and Purdue (the Sudan). The GDTA was the most professional and appropriate, Laurentian the least experienced and Purdue the least appropriate. This is not a reproach of any institute; it must be borne in mind that testing different philosophies and techniques for the application of remote sensing data was an inherent objective of the overall exercise.

Institutional capability is more difficult to assess. In Mali, the institutional environment is shoddy physically and seems chaotic

administratively. In the Sudan there is a real danger of diffusion of effort, duplication and waste as there has not yet emerged a central recognized centre of excellence for the technology. In Tanzania the team and administrative/physical set up are the most impressive but we must doubt, given the general bureaucratic inefficiency and lethargy prevailing in the country and upon which any endeavour must be ultimately dependent for results, what can really be done even with the best will.

Equipment is in place in Sudan and Tanzania but is under-utilized, especially in the Sudan. Too little attention was paid to setting up equipment, training in its use, and spare parts.

4. The IDRC undoubtedly brought meaningful remote sensing technology to Mali, the Sudan and Tanzania, unarguably in terms of involving local scientists. But, in each country, it has only a feeble toe hold. To survive, let alone develop, continued outside support is necessary as no country has the resources for, or the conviction yet to reallocate resources to, this activity. In assessing what IDRC might have done better, it must be remembered that technology transfer in general, and remote sensing in particular, were new activities for the IDRC and that, deliberately, it was decided to support projects in the very poorest category of countries.

This said, the IDRC could have enhanced the usefulness of its support by: consenting to longer terms, making a more intensive and thoughtful

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survey of local conditions, realities and capabilities and then determining Centre and recipient contributions in consequence, providing more technical assistance and some guidance in the administrative areas of report submission and financial record keeping and reporting, and making a more appropriate selection of trainers and training programmes.

5. The professionals involved in remote sensing are sold on the important contribution which it can make as another development tool. They have made efforts to disseminate this conviction amongst potential users and decision-makers who, from what we are told, are also convinced. It is also, however, evident that given the newness of the technology and the preoccupation of the countries with other priorities, however useful it is perceived to be it will be some time before it can capture real attention and, even more important, national financial resources. In the meantime, it must rely, for survival, upon external funding from donor agencies. In summary, two steps have been taken and the role of the IDRC in this has been determinant, but the all important third step is still to be taken.

6. No significant regional or international linkages have been made either between projects or with other countries of the region or continent beyond contacts with the ECA regional remote sensing centres in Ouagadougou and Nairobi. It would seem premature to expect them. There also has been

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no communication between the five IDRC projects beyond the Nairobi workshop held in 1978.

7. While the acquisition of remote sensing image data is a "high technology", many of the analysis and application technologies are not and are well within the capability of even the poorest countries. The constraints to use are more in the realms of selling to potential users and policy-makers the importance of the technology for development and the need of a thorough knowledge both of the technology and the conditions of the recipient so that an endeavour may be appropriate to the realities of both and thereby have some chance of effective transfer.

8. It is difficult to go beyond this and to make more general comments on the feasibility of technology transfer as an activity and as one appropriate for IDRC involvement. It must rather be considered in the context of particular technologies to be transferred to the circumstances of particular countries.

Remote sensing has an important and exciting potential to contribute significantly to the development of poor countries through assisting in the process of acquiring knowledge of natural resources cost effectively and within an acceptable time frame.

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9. We hesitate to recommend supporting additional projects of this kind in other countries. The projects supported provide a varied sampling of country circumstances and of the challenge and problems of transferring remote sensing technology to less developed countries to permit judgements to be made on methodology and effectiveness. However, as the terms of all projects were really very short to implant such a novel technology, and as manifestly its support must depend on outside resources in the short and medium term, consideration perhaps could be given to a second phase of the best project, or perhaps two projects Such second phases could include additional training, especially of technicians providing essential support services: mapping, photoprocessing, etc., equipment and vehicles and, principally, research expenses for the proper mapping and analysis exercises which fell short in all the initial projects. Bolivia, which we did not visit, but of which we heard complimentary things, could be a candidate, should the political situation of the moment allow a project to be carried out in reasonable circumstances. Of the African projects, Tanzania, which has management , trained people and facilities, might be considered. But, before doing anything with Tanzania, its performance on the first project and the real extent of national policy and user commitment to the technology, should receive a more careful investigation than time permitted us; performance is always a question mark in this land of high ideals, attractive articulate people and logistical and administrative chaos. The Sudan might also be considered. Its very size attracts one to the potential

benefits there of Landsat technology. The people trained were quite impressive and there is obvious interest on the part of planners and policy makers even if it seems a little haphazard in its expression. It must always be borne in mind, in considering a second phase of an African project, that none of them built in its first phase what would be considered a solid foundation for future activities.

It should finally be mentioned that considerable support is now being made available by multinational (e.g. IBRD, FAO, Inter-American Development Bank) and bilateral (Canada, France, Holland, Germany, U.S.A.) agencies in the general field of remote sensing and this may reduce the opportunities, and responsibilities, of a pioneering organization like IDRC for straight technology transfer exercises. It is certainly important, and feasible in this relatively new field, to know what activities other donors are supporting in order to assure that IDRC supported projects complement rather than duplicate.

10. While the Centre supported projects were certainly more in the nature of technology transfer than 'research' exercises, the integration of remote sensing data and methods with conventional approaches, to carry out resources mapping, lies clearly in the domain of applied research.

11. It cannot be said that, as a result of these projects, the recipient countries are significantly better equipped to negotiate

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access to international Landsat data but this is more because, at this point in the development and politics of the technology, it is more relevant for the intermediate powers like Canada, Sweden and Australia to be involved in such activities. While the application of Landsat data, using appropriate techniques, is within the capability of LDC's, it may fairly be said that most activities to do with its acquisition should be left to more affluent and technologically advanced nations for the time being.

Nevertheless, of course, the project recipient countries are certainly able now to attend international meetings on the subject better informed and are more able to make decisions on what would best serve their particular interests.

12. Perhaps an organization like the IDRC should concern itself more with things which a recipient and it believe to be important but which, for a number of reasons, do not command a "high priority". For example, remote sensing may be seen as extremely important for the identification of areas suitable for agriculture, which is, in turn, essential for food production, but the activity will attract extremely little support if people are starving and a more immediate concern is feeding them by whatever means and even if only for a short time.

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E. CONCLUDING COMMENTS

The Information Sciences Division has supported a group of projects in some of the very least developed countries. From this experience some significant lessons have been learned about the feasibility of transferring remote sensing technology from the developed to the less developed world, and about technology transfer in general. At least with respect to the three African projects, with none can it truly be said that a solid foundation in the technology has been built which would make additional support, through second phase projects, imperative and productive. It is also felt that little would be gained by supporting another round of similar projects in different countries. Not much more would be learned and we cannot be sanguine that, with small budget/small term projects, the technology would be any better established than in the cases of the three African projects. If the technology transfer in Bolivia seems better rooted, continuing political instability there suggests caution for the time being.

2. The authors have discussed with officers of the Information Sciences Division some program possibilities they envisage for the cartographic program, in developing remote sensing, in the immediate future. Although it is not strictly part of this evaluation, the following comments are offered:

- The possibility has been discussed of the Centre supporting a resource person at the Centre Regional de Télédélèction et Oucgarougon in Haute Volta who would primarily be involved in remote sensing technology transfer and who might develop and counsel a network of small vertical programs in the region which would also be funded by the IDRC. We are attracted by the concept of geographical concentration in so vast, varied and complex an area as Africa, by the strategy of working out of an existing regional centre, by the recognition

of the necessity of technical assistance, and by the cooperative network approach. If in principle, the planning, the centre could offer support over a realistically adequate period, it could be very helpful. Of course success would also depend greatly on how well the centre is staffed, equipped and managed, the competence of the IDRC resource person, the quality of the national small projects selected and all the other factors which, in development, make or break even the most inspired initiatives.

- The usefulness of supporting the transfer of appropriate mapping technologies in Africa is being considered. Certainly every African project complained forcefully of the inadequacy of their national map production facilities and services and most especially in the area of thematic map production. Equally certain is the importance to development planning and project execution of accurate maps of adequate quality. In other words it is important to develop the capability for presenting data, remotely sensed and from other sources, in cartographic formal usable by planners. There will be arguments of what is 'adequate quality'. (We take issue with the Tanzania project: peoples contention that maps produced by Clark University, are of the very best quality, are essential to 'sell' policy makers on the necessity of taking certain development decisions. Because of the cost and delays of producing maps in this way in or for a poor country like Tanzania, something is quite distorted if this is so). But assisting in identifying an appropriate technology, and helping to transfer it, seem only a small part of actually producing the map products that are needed, and in a useful time. What about equipment, service and supplies? What about management? They are key areas

in map production and ones in which the standard IDRC project could have little influence. The suggestion was perhaps to support a cartographer in Nairobi, Kenya, at the Regional Centre for Services in Surveying and Mapping and the Regional Remote Sensing Faculty who wanted them to be available to assist in some way in mapping endeavours of countries in East and Central Africa. It was not clear to us whether there would also have to be support to small national projects, perhaps linked in a network.

3. Certainly adequate maps are as necessary as they are lacking; as certainly there seems little agreement on what constitutes an appropriate mapping technology and there would seem to be a clear requirement for technical assistance. But any assistance contemplated should be carefully thought out to assure that, in the circumstances of the potential beneficiaries, it has a chance of being significantly useful.

4. This is an area of clear need but one in which the modalities of effective assistance are tricky, and of course the element of 'research', which would justify the involvement of the Centre, is less apparent than the character of straight technology transfer.

- At San José, Costa Rica, the possibility has been considered of supporting a facility there for the dissemination of remote sensing information. It has been stated that one of the primary conditions for the development of a viable remote sensing program is access to technology. One of the most severe limitations on access is imposed not by the technology itself but by the language in which its development is recorded and in which current experience is made available. The barrier of language must be recognized for it is already being encountered. From the standpoint of developing countries, Spanish is the most

appropriate language to consider first (the technology is already expressed in French and English). such a documentation centre is to provide access by Spanish-speakers to a level of technology adequate for self-sustained development, then the authors would, in general terms, find the proposal supportable.

5. The authors have questioned the solidity of the technical foundations resulting from the African projects. Should, nevertheless, it be decided to consider second phases of one or more of the first group of projects, the emphasis of the second phase projects should be on the development of a 'product' such as a resource inventory, a land use plan, erosian studies, comparative crop condition studies, etc., in other words, that part of the first phase projects which in all cases fell short. It is generally considered that developing such a product, seriously and professionally would be the best possible training vehicle.

6. However, given the finite financial resources of the Information Sciences Division, and the call upon these resources from other research areas within the Division's general field of activity, obviously priorities must be established and choices made. It would be inappropriate for the authors, who are not familiar with all the various demands on the resources of the IS Division, to make specific recommendations as to the priority which would be assigned by the Centre to a cartography program and in particular to follow on remote sensing activities. It can be stated however, that the IDRC experience have in the past, and its intentions as to what best to do in the future, is common to most organizations supporting this technology. However, these organizations also show the belief that remote sensing is becoming an invaluable technology for the support of successful introduction of this technology will continue to require projects which recognize the needs for appropriate technology, expertise and support and useful output projects.